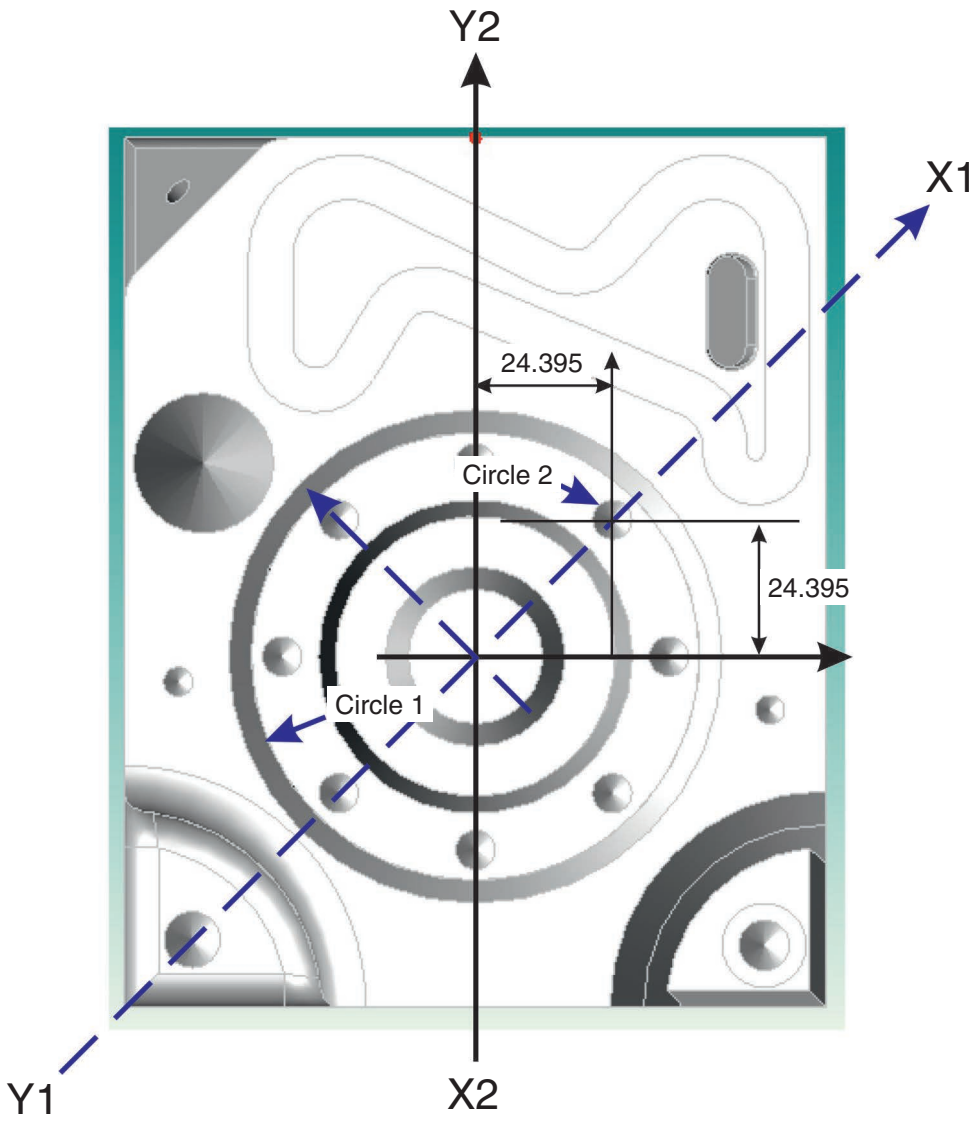
RENISHAW
apply innovation™

Part alignment - plane and two circles (one offset) (CAD)



X1 - Y1: Coordinate system through the two holes.

X2 - Y2: Coordinate system corrected via rotation.

Disclaimer

Considerable effort has been made to ensure that the contents of this document are free from inaccuracies and omissions. However, Renishaw makes no warranties with respect to the contents of this document and specifically disclaims any implied warranties. Renishaw reserves the right to make changes to this document and to the product described herein without obligation to notify any person of such changes.

Trademarks

All brand names and product names used in this document are trade names, service marks, trademarks, or registered trademarks of their respective owners.

Renishaw part no: H-1000-5313-01-B

Issued: 12 2014

Part alignment - plane and two circles (one offset) - CAD

Care of equipment

Renishaw probes and associated systems are precision tools used for obtaining precise measurements and must therefore be treated with care.

Changes to Renishaw products

Renishaw reserves the right to improve, change or modify its hardware or software without incurring any obligations to make changes to Renishaw equipment previously sold.

Warranty

Renishaw plc warrants its equipment for a limited period (as set out in our Standard Terms and Conditions of Sale) provided that it is installed exactly as defined in associated Renishaw documentation.

Prior consent must be obtained from Renishaw if non-Renishaw equipment (e.g. interfaces and/or cabling) is to be used or substituted. Failure to comply with this will invalidate the Renishaw warranty.

Claims under warranty must be made from authorised service centres only, which may be advised by the supplier or distributor.

Trademarks

Windows 98, Windows XP, Windows 2000 and Windows NT are registered tradenames of the Microsoft Corporation.

IBM is the tradename of the International Business Machines Inc

All trademarks and tradenames are acknowledged.

Contents

1 Part alignment - plane and two circles (one offset) - CAD

1.1 Tutorial pre-requisites

- The student should be familiar with the ‘Principles of part alignment’
- The student should have covered ‘Part alignment - Plane, line and point’ and ‘Part alignment - plane and two circles’

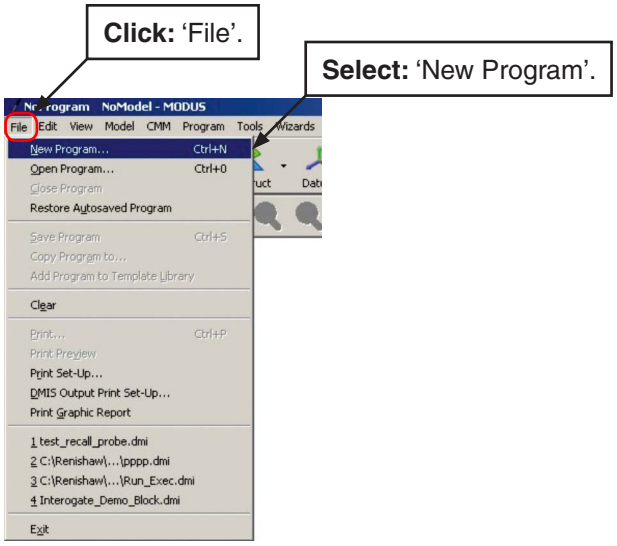
1.2 Tutorial objectives

- Further exposure to feature measurement and constructions
- Introduction to datum manipulation - rules and practical application

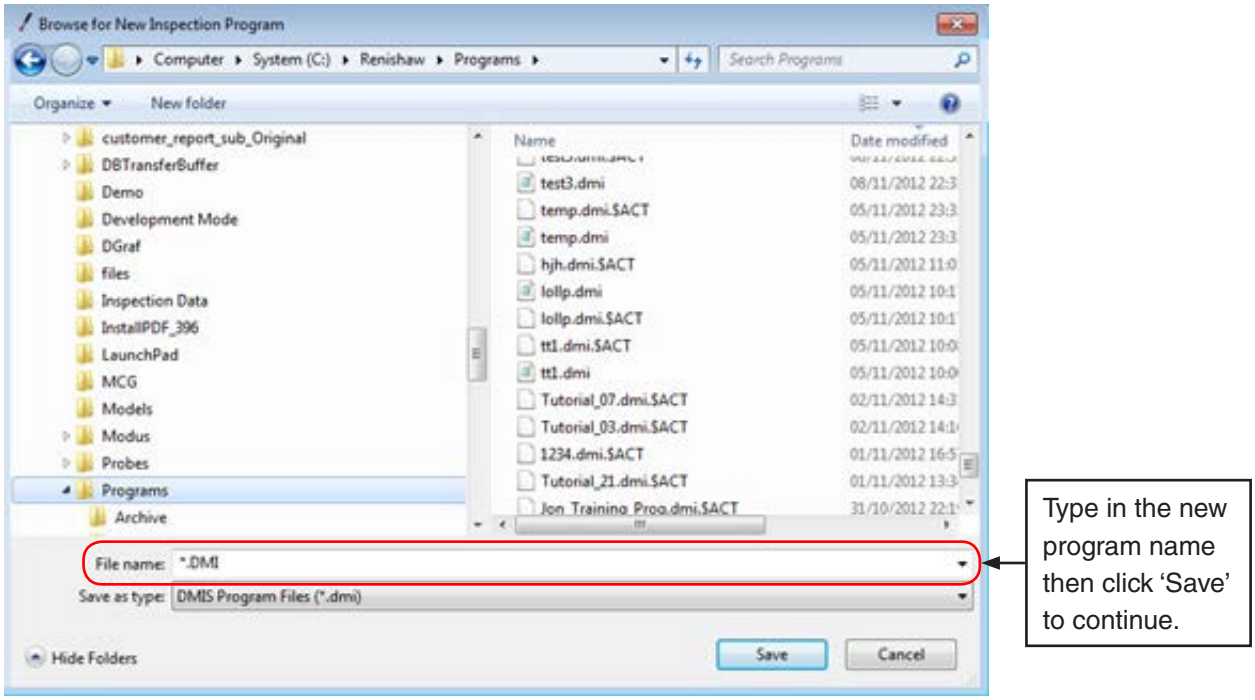
2 Introduction

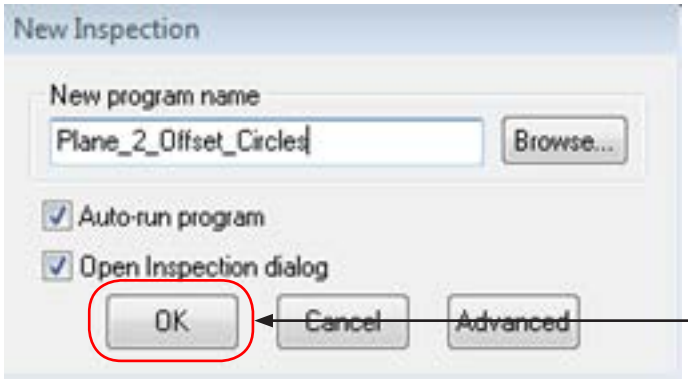
This tutorial introduces the student to a practical scenario where drawing datum requirements cannot be directly transposed from feature definitions, i.e. boxed (“reference” or “basic”) dimensions are applied. All features will be defined and visualised using a CAD model.

3 Create a new program

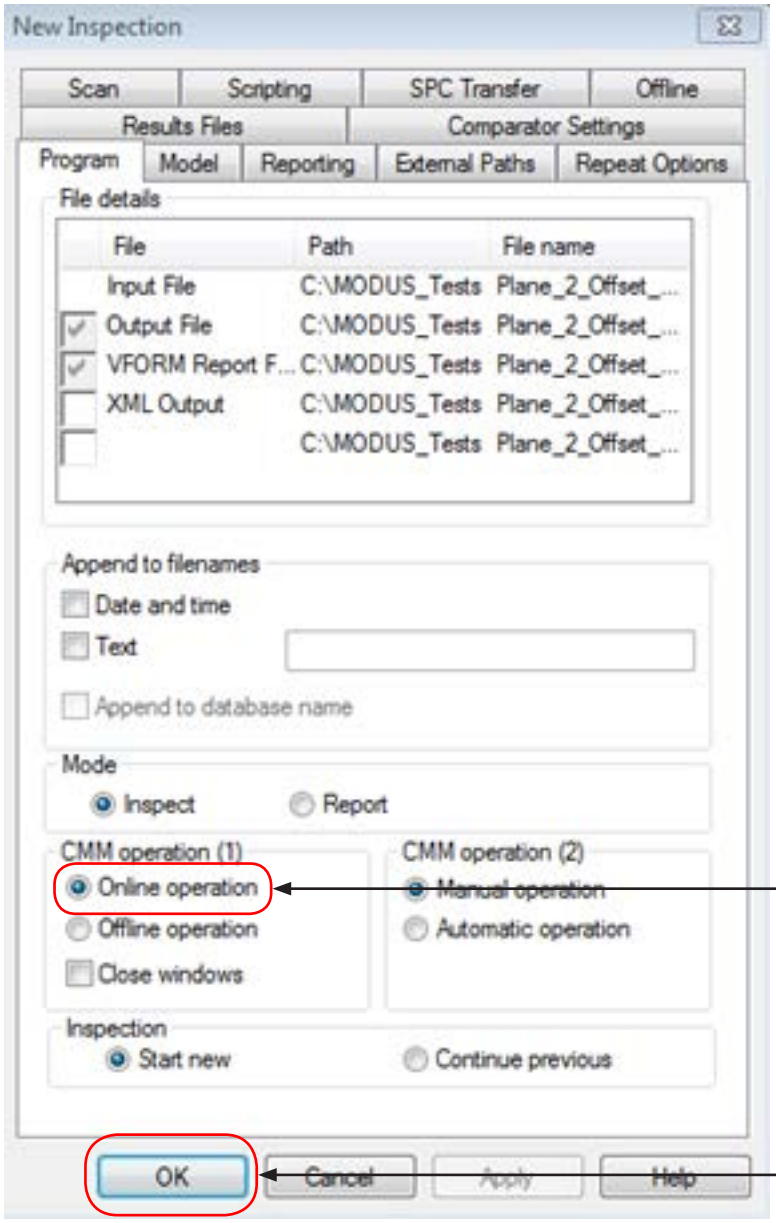


After clicking ‘Browse’ select a suitable location for the program:



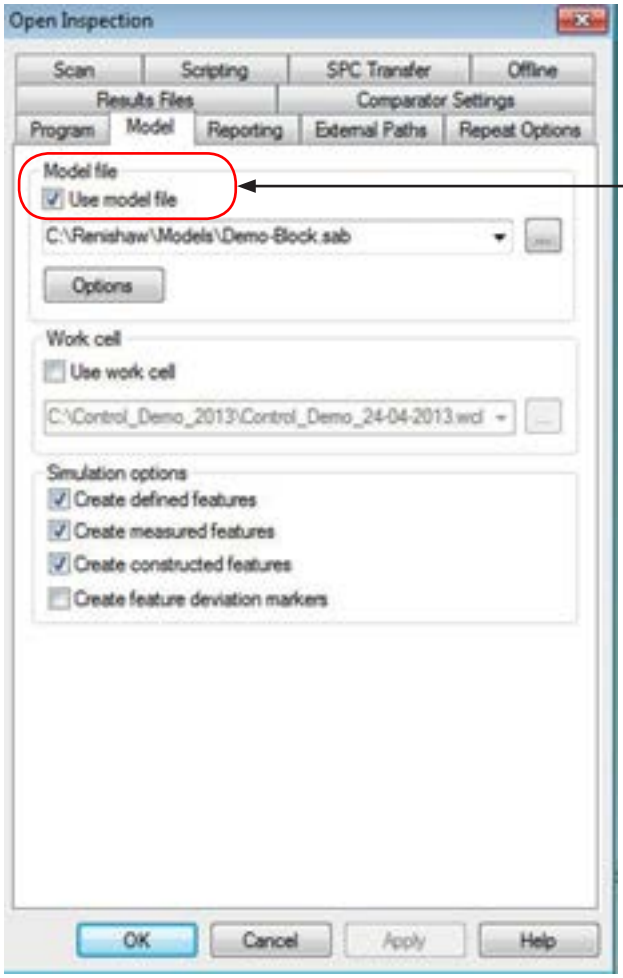


Click: 'OK' to continue.



Ensure that 'Online operation' is selected in the 'Program' tab.

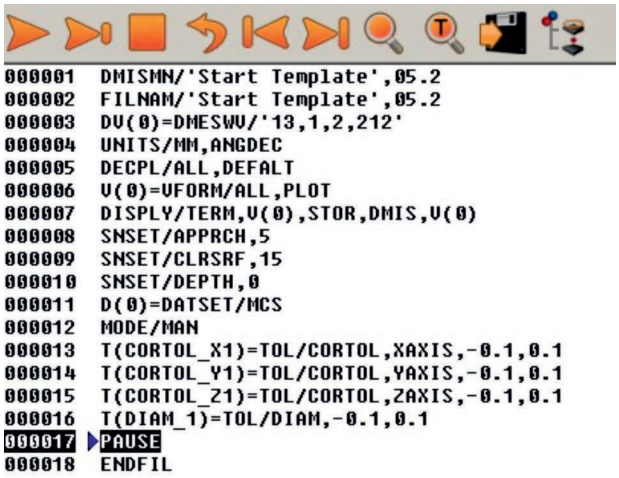
Click: 'OK' to continue.



Ensure that 'Use model file' is selected in the 'Program' tab.

Ensure that the correct CAD file is selected in the 'Model file' box. Use the 'Browse' button to locate the correct file if necessary.

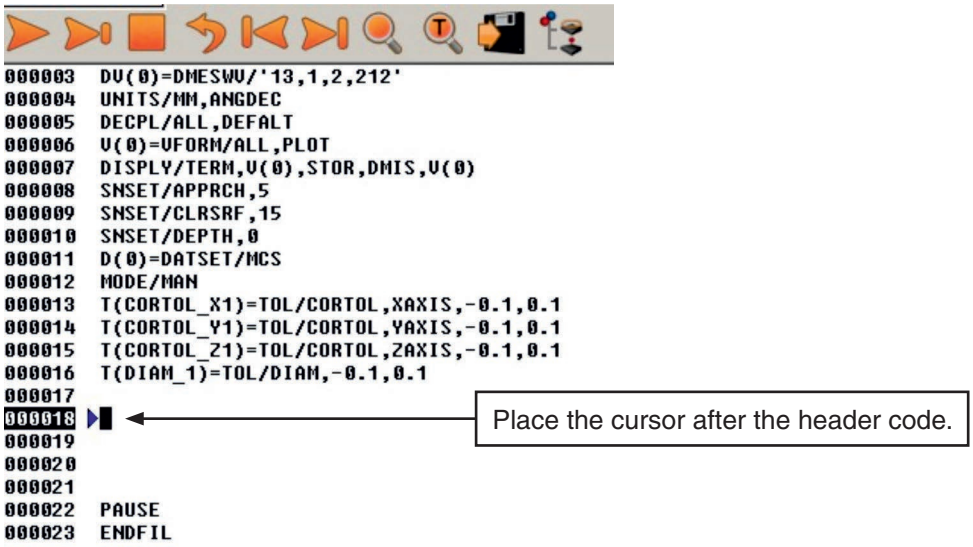
The following header will be inserted into the program:



```
000001  DMISMN/'Start Template',05.2
000002  FILNAM/'Start Template',05.2
000003  DV(0)=DMESVV/'13,1,2,212'
000004  UNITS/MM,ANGDEC
000005  DECPL/ALL,DEFALT
000006  V(0)=VFORM/ALL,PLOT
000007  DISPLY/TERM,V(0),STOR,DMIS,V(0)
000008  SNSET/APPRCH,5
000009  SNSET/CLRSRF,15
000010  SNSET/DEPTH,0
000011  D(0)=DATSET/MCS
000012  MODE/MAN
000013  T(CORTOL_X1)=TOL/CORTOL,XAXIS,-0.1,0.1
000014  T(CORTOL_Y1)=TOL/CORTOL,YAXIS,-0.1,0.1
000015  T(CORTOL_Z1)=TOL/CORTOL,ZAXIS,-0.1,0.1
000016  T(DIAM_1)=TOL/DIAM,-0.1,0.1
000017  PAUSE
000018  ENDFIL
```

Insert some line spaces to make the program easier to read. Press ctrl I

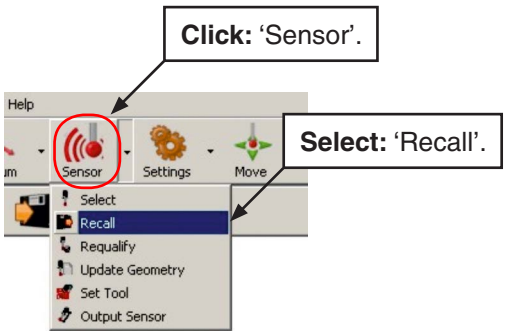
Enter a space here and then press return.

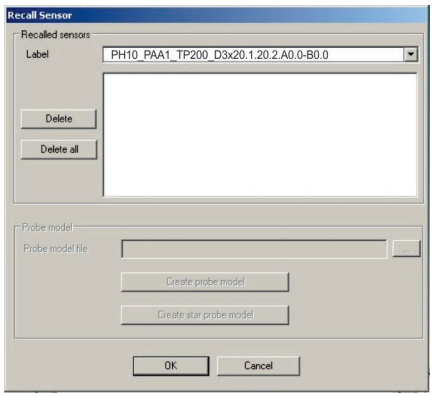


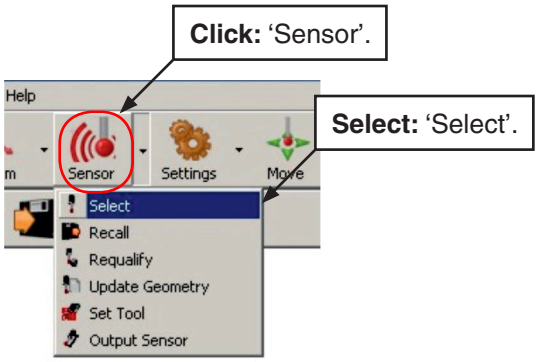
Place the cursor after the header code.

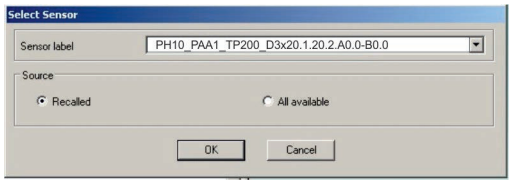
The sensor that is to be used needs to be recalled and selected.

Recall the tool by clicking ‘Sensor’ then selecting ‘Recall’:









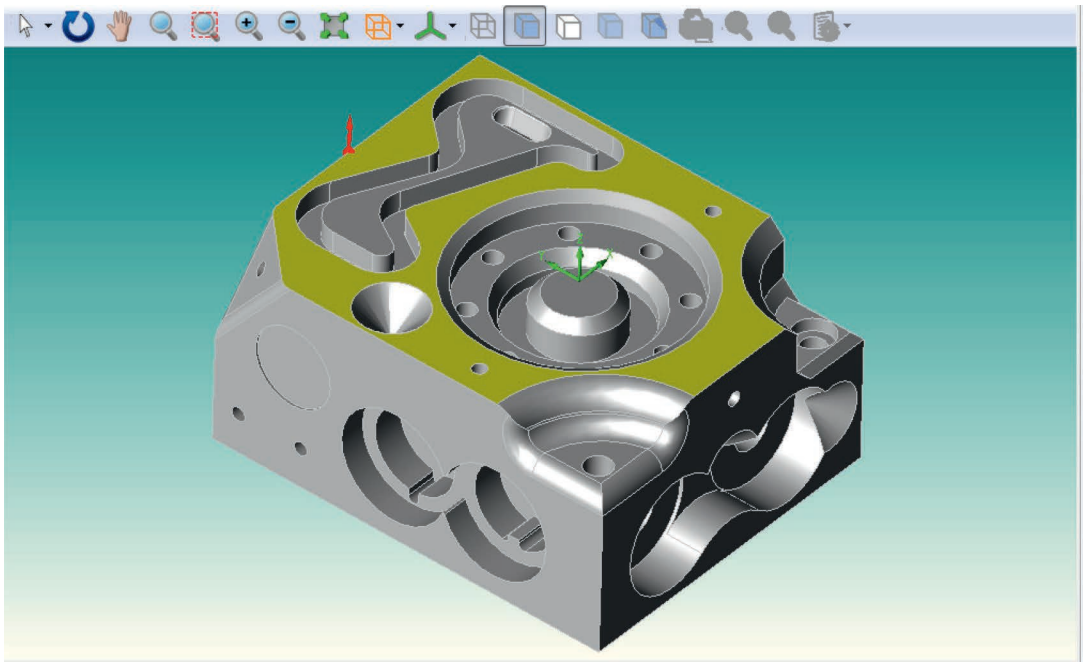

```
000012  MODE/MAN
000013  T(CORTOL_X1)=TOL/CORTOL,XAXIS,-0.1,0.1
000014  T(CORTOL_Y1)=TOL/CORTOL,YAXIS,-0.1,0.1
000015  T(CORTOL_Z1)=TOL/CORTOL,ZAXIS,-0.1,0.1
000016  T(DIAM_1)=TOL/DIAM,-0.1,0.1
000017
000018  RECALL/SA(PH10_PAA1_TP200_D3x20.1.20.2.A0.0-B0.0)
000019  SNSLCT/SA(PH10_PAA1_TP200_D3x20.1.20.2.A0.0-B0.0)
000020
000021
000022
000023  PAUSE
000024  ENDFIL
```

The program will now have two additional lines which recall and select the tool.

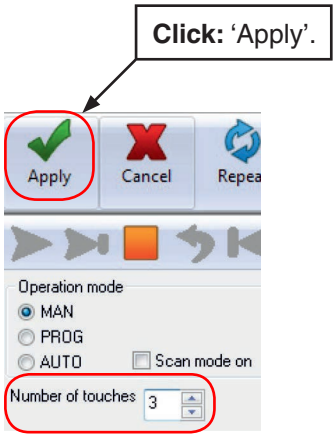
4 Measure a plane and two circles

A plane and two circles must be measured so they can be used to align the part.

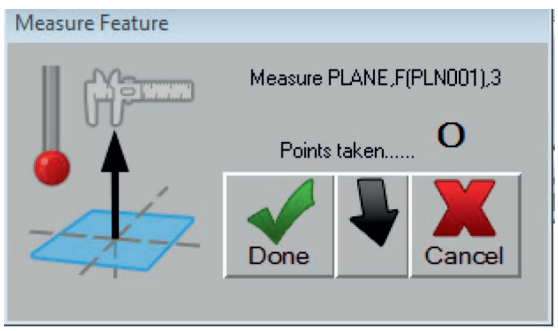
Click on the top face of the CAD model to select it:

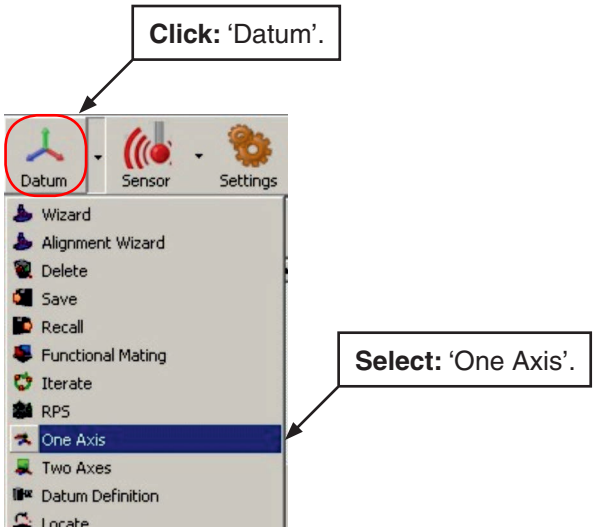


By clicking on the CAD model, input the number of points to be taken, click ‘Apply’:

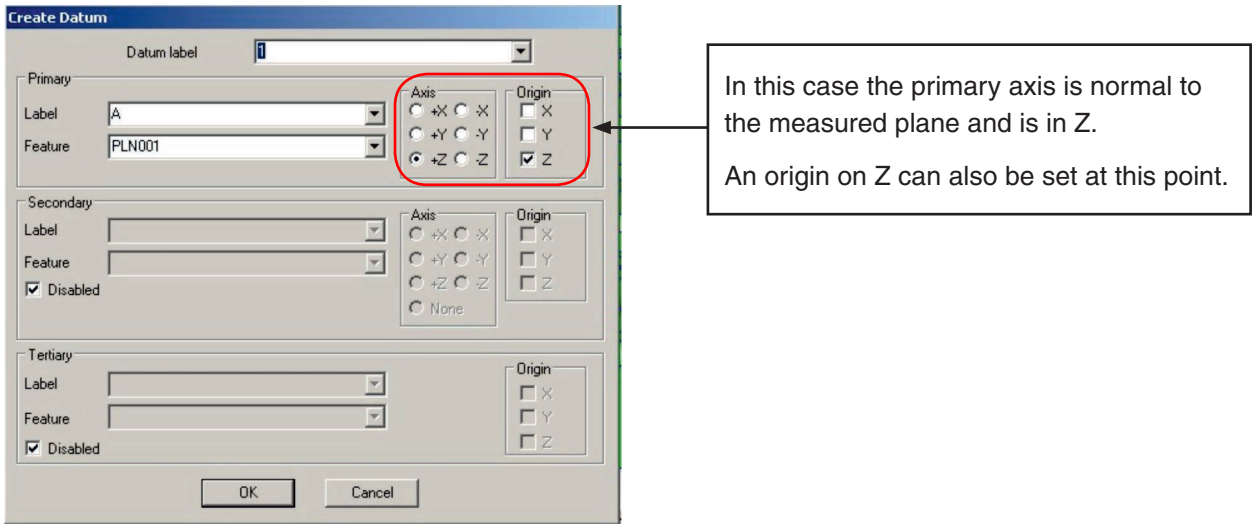


Measure the points on the top face:



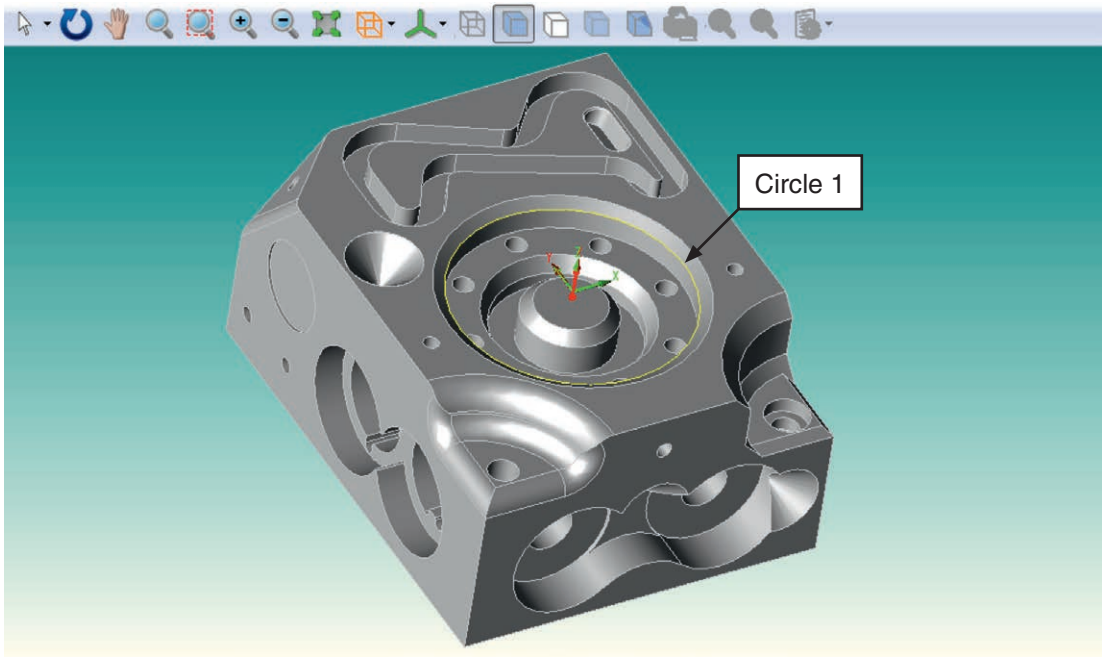


The 'Axis' radio button group is used when an axis is to run through the centroid of the feature. Similarly, the 'Origin' checkboxes can be used where the feature centroid is to be an origin.

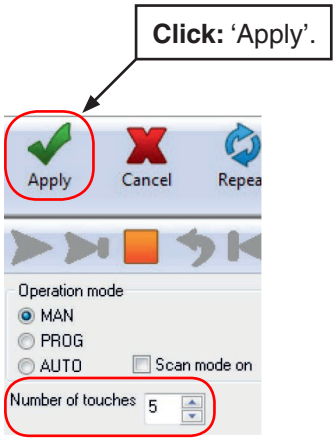


GUIDANCE NOTE: Since only a primary axis has been defined, the secondary and tertiary axis fields have been disabled. This is done by default when using 'One Axis' datums.

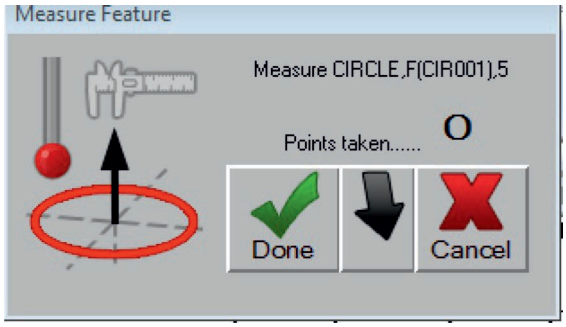
Select the bore to be measured (circle 1) on the CAD model:

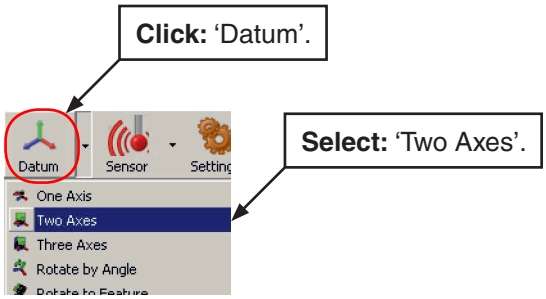


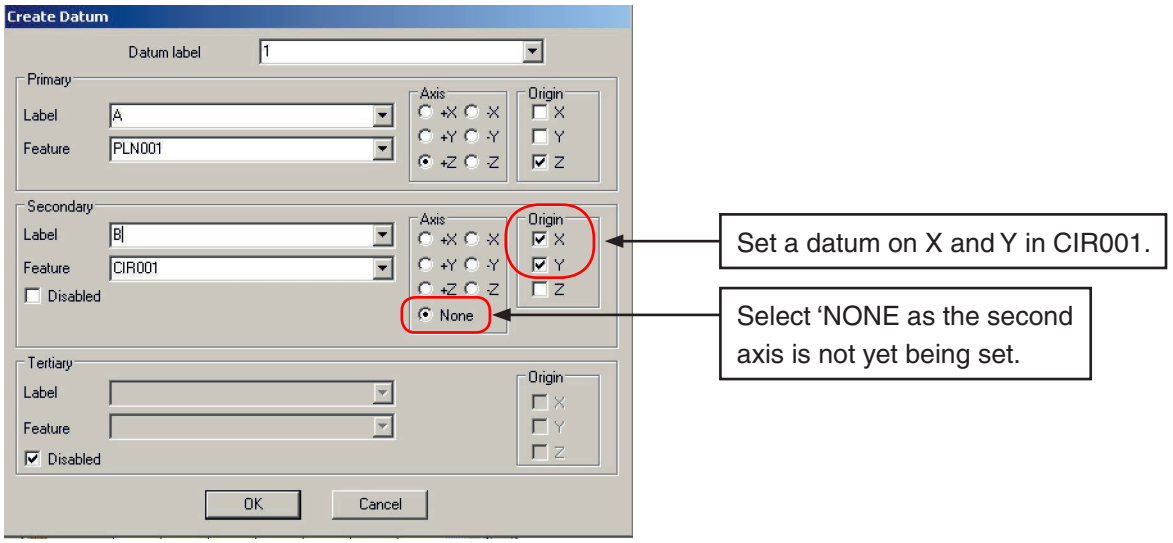
Input the number of points to be taken, click ‘Apply’:



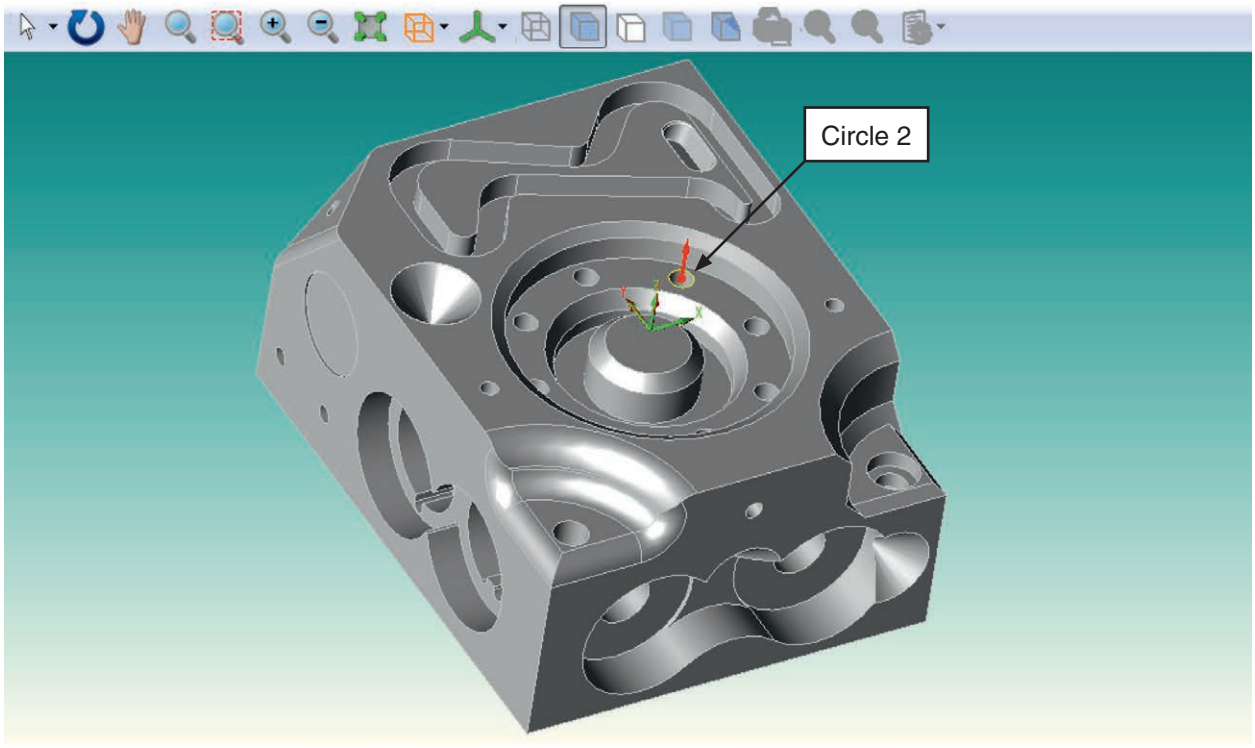
Measure the points on the top face:







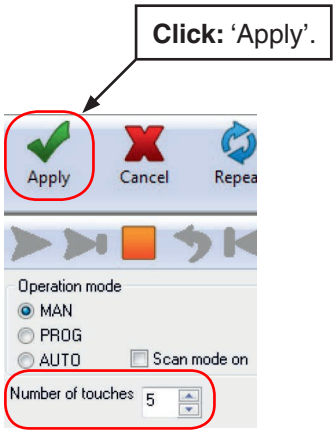
Select the bore to be measured (circle 2) on the CAD model. Note that this is 45° away from both the X and Y axes.



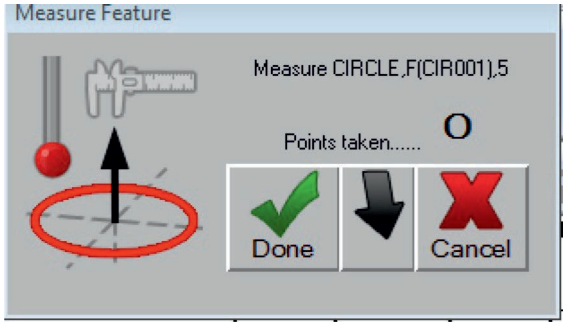
5 Construct a line from measured data

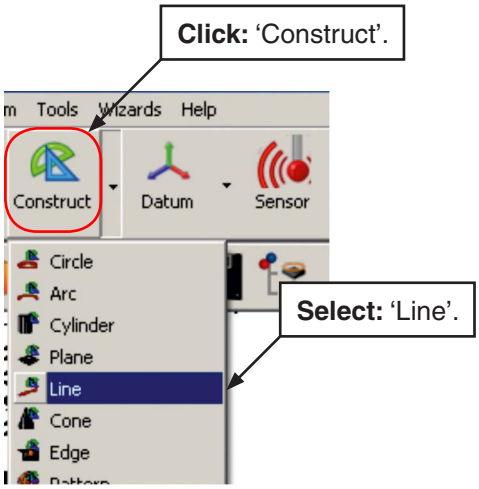
To provide a feature to lock the rotation of the datum, a line will be constructed between the centres of the two measured circles.

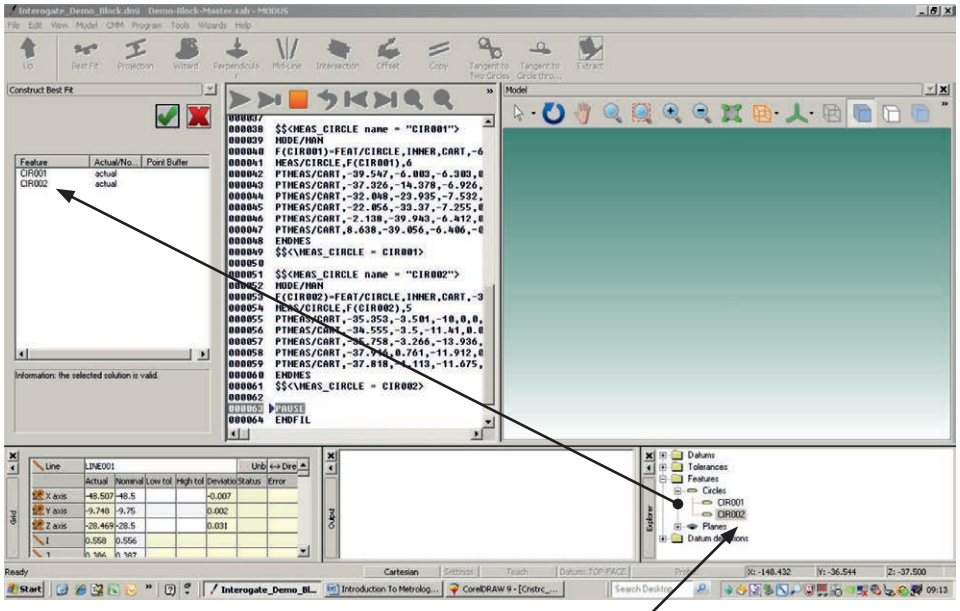
Input the number of points to be taken, click ‘Apply’:



Measure the points in the bore:



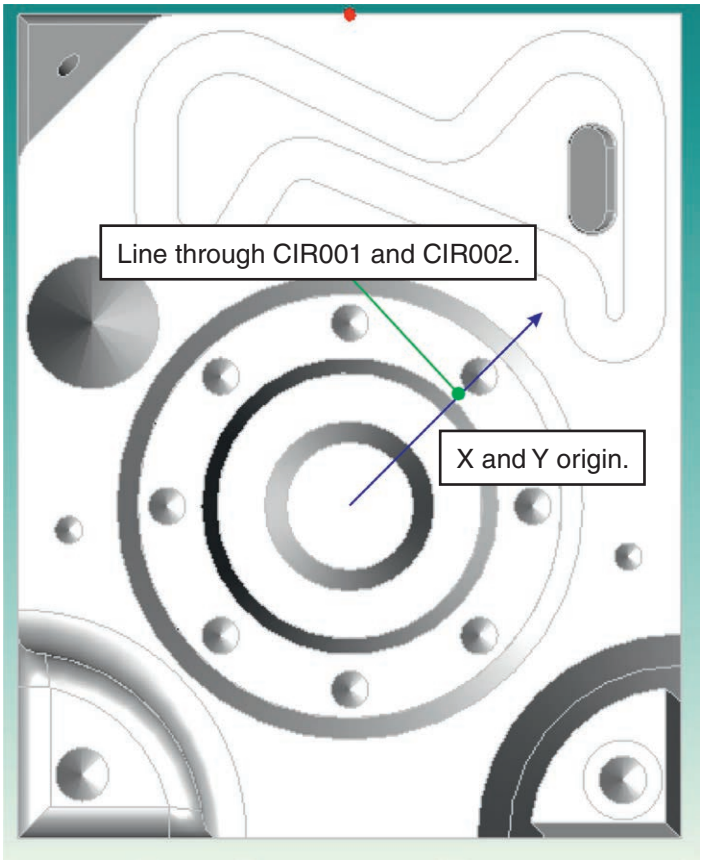




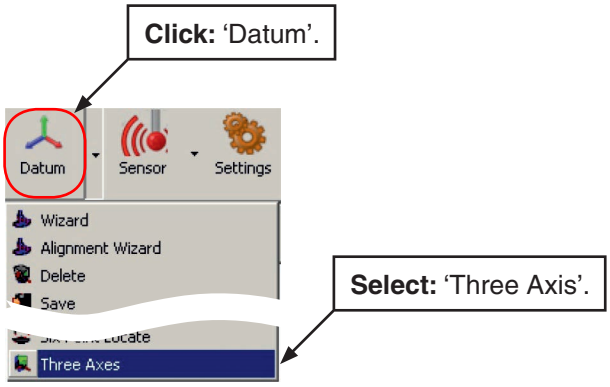
Click: 'Apply' to complete the construction cycle.

Code produced:-

F(LINE001)=FEAT/LINE,UNBND,CART,57.5,20.13,-40,0,-1,0,-1,0,0
CONST/LINE,F(LINE001),BF,FA(CIR001),FA(CIR002)



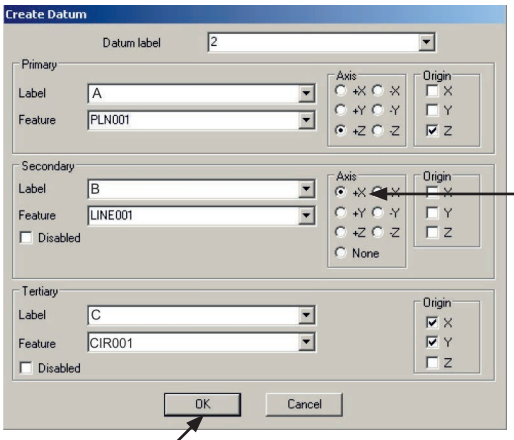
There are now enough features to fully define a datum.



In this case PLN001 is the PRIMARY AXIS [+Z]

LINE001 is the SECONDARY AXIS [+X] (no origin here)

CIR001 is the TERTIARY point origin [X and Y]

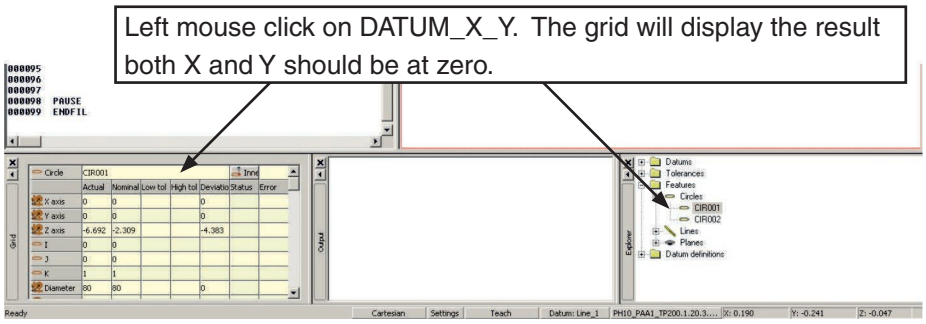


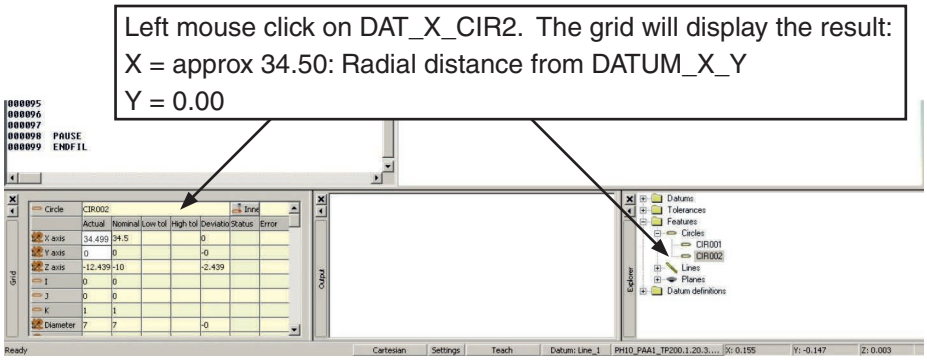
In this case the constructed line lies along the X axis.

NOTE: There is also the option of selecting -X or +Y/-Y.

Click: 'OK' to complete the procedure

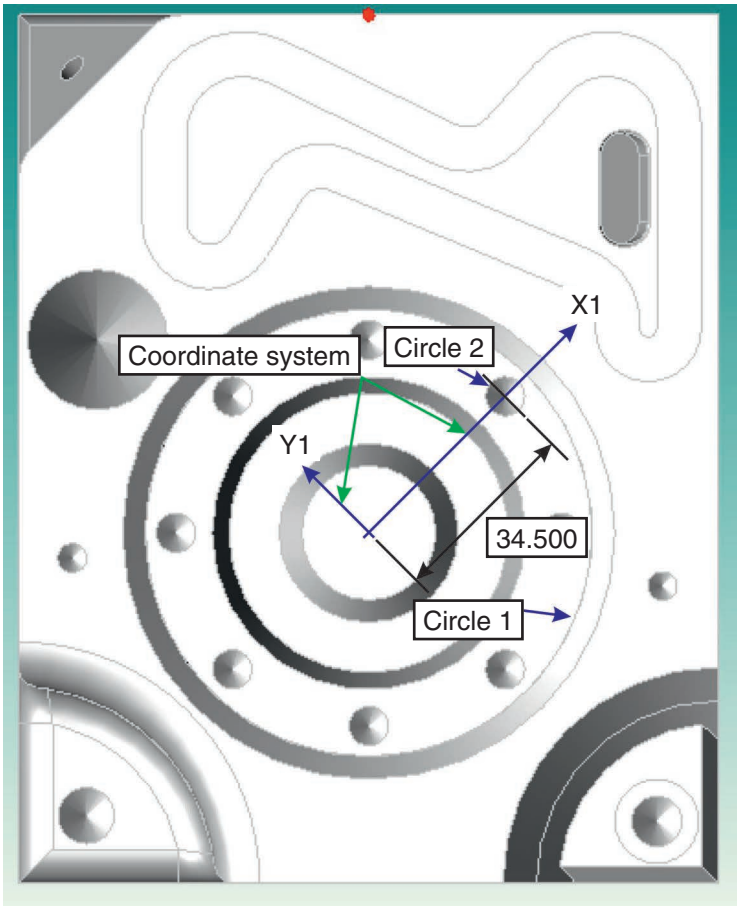
Now check if both circles are in the correct positions:





Currently the constructed line lies along the X axis. However, the constructed line needs to be at 45° to the X axis so the coordinate system must be rotated.

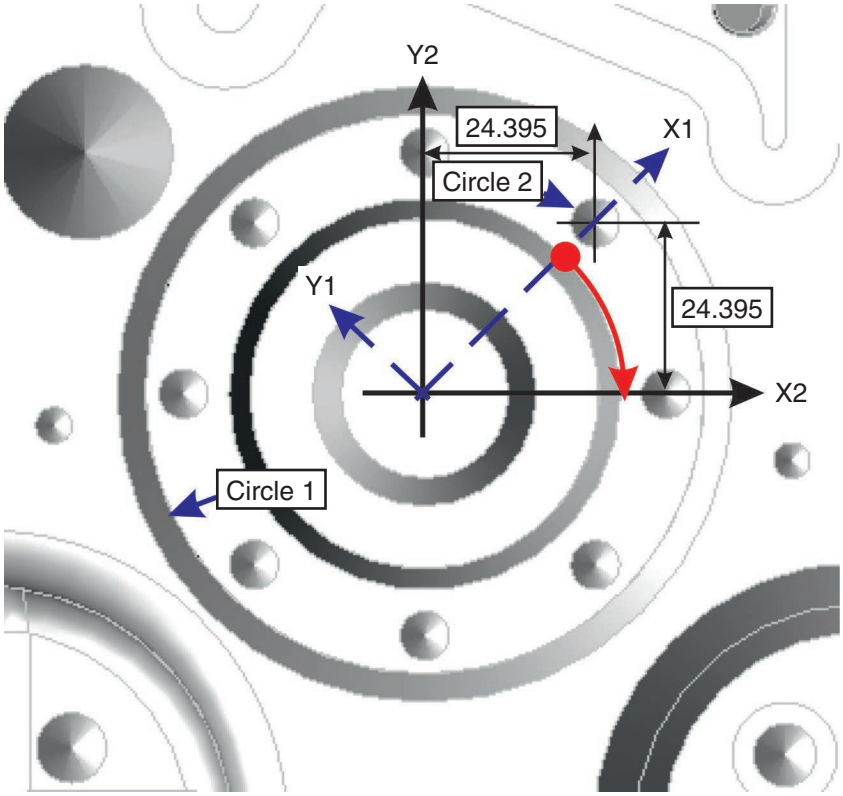
6 Rotate co-ordinate system by angle



Now make a theoretical rotation using the defined angle through the two co-ordinates given i.e:-

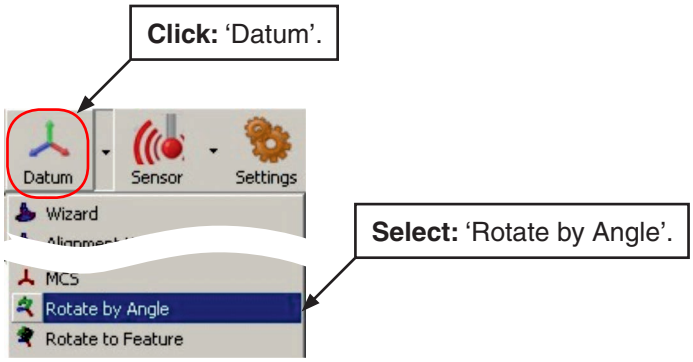
X = 24.395 and Y = 24.395

Angle = Inv Tan (24.395 / 24.395) = 45°

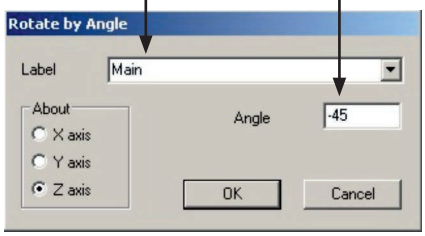


In this case the X and Y axes are to be rotated clockwise by 45°.

NOTE: -ve angles give clockwise rotation, +ve angles give anti-clockwise rotation.



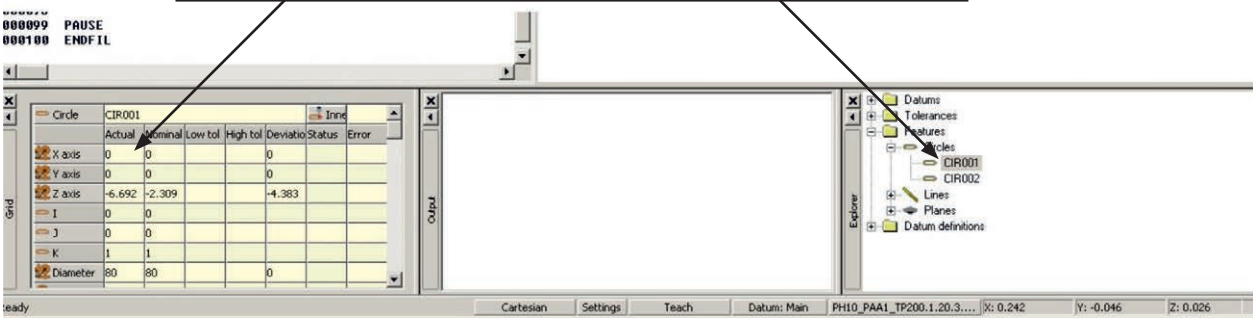
Enter a label for the final alignment and enter the required angle of rotation, in this case about the Z axis.



The coordinates of the two circles can be checked to confirm the correct rotation has been applied to the coordinate system.

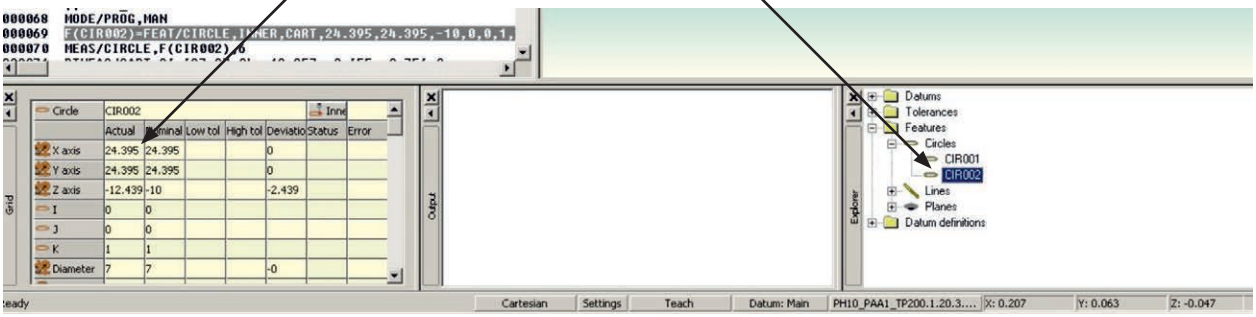
Left mouse click on CIR001. The grid will display the result.

Both X and Y should still be at zero.



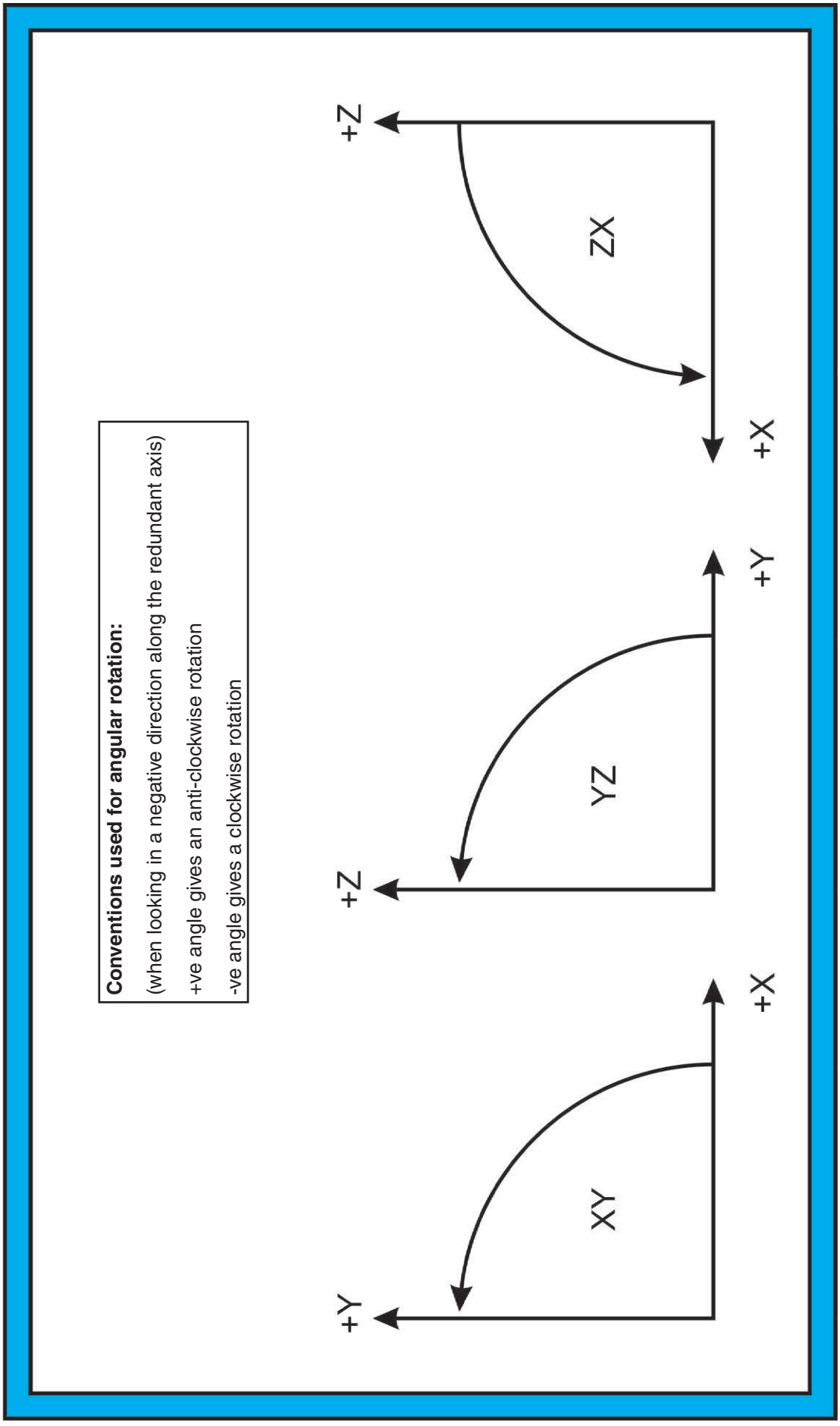
Left mouse click on CIR002. The grid will display the result:

X = 24.395, Y = 24.395.



The component has now been manually aligned. A more precise CNC alignment should be carried out prior to measurement being undertaken. This will be explained in a subsequent tutorial.

GUIDANCE NOTE: It is good practice to save the datum by selecting 'Datum' and then 'Save'. This allows the datum to be recalled later in the program.


Conventions used for angular rotation:
(when looking in a negative direction along the redundant axis)
+ve angle gives an anti-clockwise rotation
-ve angle gives a clockwise rotation
+Z
ZX
+X
+Z
YZ
+Y
+Y
XY
+X

This page intentionally left blank

Renishaw plc

New Mills, Wotton-under-Edge,
Gloucestershire, GL12 8JR
United Kingdom

T +44 (0)1453 524524
F +44 (0)1453 524901
E uk@renishaw.com

www.renishaw.com

RENISHAW
apply innovation™

For worldwide contact details, please visit our main web site at www.renishaw.com/contact

H-1000-5313-01